The J Factor: A New Methodology for Interdisciplinary Comparison in Scientific Evaluation using Journal-Based Publication Profiles

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Background

The widespread use of the performance-oriented allocation of funds and excellence initiatives in science and research has led to questions concerning fair national and international bibliometric benchmarks for comparing scientific institutions becoming a hot topic [Wagner-Döbler, 2003].

Application

The focus of science evaluation is based on research institutions as creators of a steadily growing, multidisciplinary scientific output [Price, 1963]. These compete with each other to rank among the leading institutions in their disciplines and also to document their position through the perception of their publications. Since the range of publications is ever increasing worldwide, a global competition takes place [see Mervis, 2007; Broad, 2004] with the scientific institutions as its main actors. The aim is to achieve the highest visibility for institutions and countries [Da Pozzo et al., 2001].

Especially for multidisciplinary institutions, the evaluation of an institution's ranking in comparison to a benchmark is not easy to conduct [Adam, 2002]. When comparing on an interdisciplinary basis, a normalisation must be carried out: "Citation (and publication) practices vary between fields and over time" [Garfield, 1989] because the disciplines fall back on different methods to identify problems and to tackle them. Here, different communication methods also come into play.

Methods

In this paper, we present a journal-based normalisation method, which differs from a normalisation based on subject categories:

1. Each article is only counted once. In this way, distortions caused by assigning the same article to several subject categories are excluded.

2. The field-normalised ranking according to subject categories does not consider whether a publication was positioned in a low- or high-impact journal of the corresponding subject category[1].

These problems are overcome in the method described in this paper: an institution is compared to a selected specialist community and only the exact composition of this community determines the publication profile.

For the bibliometric evaluation of institutions, this means that the underlying comparison becomes more transparent and comprehensible when applying the journal method since the benchmark composition is easier to understand. For institutions that would either like to or need to document their scientific performance using publication and citation data, the presented method is a further step towards more transparent benchmarks and ranking methods. Details of this methodology are described in Ball, Mittermaier & Tunger [2008].

In this paper, we compare the scientific publications of individual institutes in non-academic research institutions located in Germany. The institutes belong to the following research bodies: Max Planck (MPI), Fraunhofer (FhG), and Leibniz. Each one of the institutes is characterised by its own scientific profile and each of the scientific profiles are different. Four German universities were also analysed, each with different research priorities. The bibliometric problem arises when one institution simultaneously occupies different disciplines. This is where the different communication habits come into play and prevent a comparison of multidisciplinary institutions on the basis of the citation rate.

Results

The J factor[2] is used to present a method that allows a multidisciplinary bibliometric comparison to be conducted on the basis of all types of documents listed in the Science Citation Index. Since it has been shown that opinion columns, for example, are also cited, it would be biased to exclude this group of documents from the beginning from this type of evaluation.

For every institution, the J factor is listed along with the other standard indicators P, C and CPP in order to make a dimensional comparison possible. For the present investigation, the benchmark for an institution was taken as all of the publications from Germany that were published in the journals in which the specific institution published during the period under investigation from 2003 to 2007. The citation rate of the institution was compared to the benchmark on a journal-by-journal basis in order to be able to estimate the difference between the citation rate of an institution in relation to the benchmark as a percentage in the J factor. When J was calculated, it was taken into account that an identical number of articles are not published in every journal and that every journal therefore has its own weight which is proportional to its proportion of the total output.

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1 The impact factors of journals in the same subject category can differ by two to three orders of magnitude. The subject category "multidisciplinary science", for example, includes the "Kuwait Journal of Science & Engineering" as well as "Science" and "Nature".

2 The J factor describes the relative perception J of an institution in comparison with individual specialist communities. It is calculated by summation over the ratio of the citation rates of the publications of the institution being analysed and the citation rate of all publications in each of the journals, weighed in each case with the proportion of these publications in the selected journal in relation to all of the institute's publications.

Table 1 Results of the investigation on the J factor (2003-2007)

Institution	*P*	*C*	*CPP*	***J***
Fraunhofer Institute for Applied Solid-State Physics	166	539	3.2	**72.7%**
Leibniz Forschungszentrum Dresden Rossendorf	1509	5393	3.6	**84.3%**
Fraunhofer Institute for Surface Engineering and Thin Films	98	446	4.6	**99.4%**
- Benchmark: Germany -				**100.0%**
University of Cologne	10032	52515	5.2	**100.8%**
RWTH Aachen University	10050	49957	5.0	**103.4%**
University of Bonn	12205	68532	5.6	**104.5%**
Fraunhofer Institute for Interfacial Engineering and Biotechnology	137	792	5.8	**106.8%**
Heinrich Heine University of Düsseldorf	8562	54391	6.4	**108.9%**
Max Planck Institute of Plasma Physics	1648	8235	5.0	**109.5%**
Max Planck Institute for Terrestrial Microbiology	371	4393	11.8	**115.3%**
Leibniz Institute for Neurobiology	309	2575	8.3	**117.3%**
Max Planck Institute for Polymer Research	1635	15035	9.2	**117.7%**
Leibniz Institute of Atmospheric Physics	181	1172	6.5	**123.9%**

Conclusion

The three bodies chosen represent the top research institutions in Germany, and together with the Helmholtz Association, they belong to the most important research bodies in Germany, alongside the universities. It is therefore not surprising that almost all of the institutes lie above the benchmark and that only two lie well below it. All four universities, including RWTH Aachen University, which was assessed as an elite university in a competition amongst German universities, lie above the benchmark. With 108.9 %, the University of Düsseldorf is the best of the universities investigated. The three Max Planck Institutes and the two Leibniz Institutes are the best amongst the non-academic institutions. The Leibniz IAP, which has the fourth highest average citation rate of all of the institutions investigated, clearly has the best J factor. This reflects the fact that lower citation rates tend to be produced in atmospheric physics than in the life sciences, for example, but that the Leibniz IAP is one of the most highly cited institutions within atmospheric physics.

Through the increasingly applied journal-based method, the currently prevailing method of field normalisation according to subject categories will not be replaced but rather optimised. Multidisciplinary scientific institutions, in particular, will profit from the journal-based ranking method presented here.

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